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Brief report
Validation of the Dutch version of the Hip disability and Osteoarthritis Outcome Score

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Summary

Introduction: The Hip disability and Osteoarthritis Outcome Score (HOOS) was constructed in Sweden; this questionnaire has proved to be valid for persons with hip disability with or without hip osteoarthritis (OA) and with high demands of physical function.

Objective: The objective of this study was to evaluate the internal consistency, reliability, construct validity, and floor and ceiling effects of the Dutch version of the HOOS questionnaire.

Patients and methods: After translation with a forward/backward protocol, 74 hip arthroplasty patients and 88 hip OA patients filled in the Dutch HOOS, as well as a Short Form-36 (SF-36), an Oxford Hip Score (OHS) and a VAS-pain questionnaire.

Results: The Dutch version of the HOOS questionnaire achieved excellent scores in all of the clinimetric properties.

Conclusion: The Dutch HOOS questionnaire has a good internal consistency and reliability. Moreover, the construct validity is good and no floor and ceiling effects were found. The HOOS is a good instrument for patients with different stadia of hip OA.

Key words: HOOS, Hip, Osteoarthritis, Outcome, Validity, Questionnaire.

Introduction

The Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) is a widely used, patient-administered and disease-specific instrument used by older patients[1,2]. In 1988 it was validated for patients with osteoarthritis (OA) of the hip or the knee[2]. The WOMAC is recommended by the Osteoarthritis Research Society for use in clinical trials in people with hip OA to measure pain and disabilities[3]. However, because the WOMAC does not evaluate the whole domain of patient-relevant outcome in young and active patients, it was extended, to improve its validity for those with high demands of physical function. Dimensions concerning sport and recreation and hip-related Quality of Life were added to the WOMAC and thus the Hip disability and Osteoarthritis Outcome Score (HOOS) was constructed in Sweden[4].

The Swedish version of the HOOS has been validated for use in patients with hip disability with or without hip OA in secondary care and is considered to be useful for the evaluation of patient-relevant outcomes in patients after a total hip replacement (THR)[5]. The content validity was ensured through a literature search involving interviews with more than 100 patients with hip disability[6] and by questioning 90 patients undergoing THR[5]. A high test–retest reliability was found (intraclass correlation coefficients: ICCs 0.78–0.91) for all subscales of the HOOS[6]. For the construct validity Spearman correlations of 0.49–0.66 were found between the HOOS subscales and the Short Form-36 (SF-36) subscales[5].

After a systematic review of the literature on psychometric evaluation of OA questionnaires Veenhof *et al.* reported that the HOOS questionnaire was one of the top three questionnaires with the best ratings for its descriptive and psychometric qualities to evaluate both pain and physical functions[7]. Furthermore, Veenhof *et al.* concluded that the HOOS has not been studied extensively and that its rating would probably improve if more studies were conducted on its psychometric qualities[7].

The purpose of this study was to translate the HOOS into Dutch and to evaluate the clinimetric quality of the Dutch version of the HOOS as expressed by internal consistency, reliability, construct validity, and floor and ceiling effects in patients with OA of the hip in primary care and in patients with a THR in secondary care.

Methods

The study was divided into two stages: first, the Swedish version of the HOOS was translated into Dutch according to a standardized procedure described by Beaton *et al.*[8], and

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secondly it was tested for clinimetric quality in a prospective study.

PROCEDURE OF TRANSLATION

The procedure of translation included three steps[8]. Firstly two persons (T1 and T2) translated independent of each other the Swedish version of the HOOS into Dutch (forward translation); one translator had a technical background and the other had a medical background but both were native speakers. Based on a consensus meeting one final version (T-12) was formed.

Secondly, two bilingual persons (T3 and T4), one with a background in education and the other with a chemical background but both native Swedish speakers, independently re-translated this Dutch version (T-12) into Swedish (backward translation). They were blind to the original Swedish version.

Eventually all translators had a consensus meeting to consolidate the final version of the Dutch version of the HOOS which was used in the present study. This final version was presented to a subset of 15 patients. These patients were asked whether they understood all items and whether they had problems with the formulation of the items of the Dutch version of the HOOS. None of the patients reported problems with the items of the HOOS.

PATIENTS

Two study populations with mild to moderate and severe OA participated in this study to evaluate the Dutch version of the HOOS. The first group consisted of a random selection of patients with hip OA who participated in the Glucosamine sulphate OsteoArthritis Long-term efficacy study[9]. These patients were recruited from general practitioners in the Rotterdam area, and were included in the study when they met one of the American College of Rheumatology criteria for hip OA. Patients who had already undergone THR or those on the waiting list for THR were not included in the study; nor were patients with a Kellgren & Lawrence score of grade 4[9].

The second study population consisted of patients who had undergone THR because of primary or secondary OA at the Department of Orthopaedics (Erasmus Medical Centre, Rotterdam). Mean duration after THR was 9.5 months (SD 3.7). Of the patients who had undergone THR between September 2003 and October 2004, 87 were invited to participate in the present study. Patients unable to understand Dutch written language were excluded. The study was approved by the Medical Ethics Committee of the Erasmus Medical Centre.

Participants were asked to fill in four questionnaires at home, namely the Dutch HOOS, the SF-36[10], the Oxford Hip Score (OHS)[11] and a visual analogue scale (VAS) for pain[12]. For test–retest studies the time interval needs to be sufficiently short to support the assumption that the patients remain stable, and sufficiently long to prevent recall[13]; a retest interval of 2–14 days is usual[14]. We considered a time interval of 3 weeks to be appropriate for the current population.

Questionnaires

HOOS

The HOOS includes five subscales: Pain, other Symptoms, Function in Daily living (ADL), Function in Sport and Recreation (Sport/Rec), and hip-related Quality of Life (QoL). Standardized response options are given (5-point Likert scale) and each question is scored from 0 to 4; then a normalized score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated for each subscale. The user's guide can be downloaded from www.koos.nu. The format is user-friendly and takes about 10 min to fill in. HOOS is self-explanatory and can be administered in the waiting room or used as a mailed survey[5].

SF-36

The SF-36 is a generic health status questionnaire which contains 36 items. It measures eight major attributes (bodily pain; physical function; social function; role limitations because of physical problems; role limitations because of emotional problems; mental health; vitality; general health perceptions)[15]. It is widely used, reliable and validated into Dutch, and is easy to fill in[10].

OXFORD HIP SCORE

The OHS is a disease-specific questionnaire consisting of 12 questions assessing pain and function of the hip in relation to different activities of daily life. Standardized response options were given (5-point Likert scale) and each question was scored from 1 to 5; then a summary score (12 indicating no difficulties symptoms and 60 indicating most difficulties) was calculated. The OHS was developed specifically to assess outcomes of hip arthroplasty and has shown to be consistent, reliable, valid and sensitive to clinical change[16]. The Dutch OHS has shown to be valid and reliable in measuring outcome in THR patients[11].

VAS FOR PAIN

The VAS for pain is a simple way of measuring the intensity of pain. The 100-mm VAS is a uni-dimensional scale and it is considered to be valid and reliable[12].

STATISTICAL ANALYSIS

Hypotheses were formulated about the expected magnitude and direction of relationships between (subscales of) the HOOS and the other instruments (see Table I). We defined the construct validity of the HOOS as good if $\geq$75% of the hypotheses could be confirmed[17]. Data were analysed with SPSS statistical software version 10.1. The level of significance for all statistical procedures was $P \leq 0.05$.

Internal consistency

A high degree of homogeneity is desirable in a scale. This has two implications: (1) the items should be moderately correlated with each other, and (2) each should correlate with the total scale score[14]. These two factors form the basis of the various tests of homogeneity or internal consistency of the scale. The internal consistency was determined by calculating the Cronbach's alpha. The widely-accepted social science cut-off is that Cronbach's alpha should be 0.70 or higher for a set of items to be considered a (sub)scale[14,18].

Reliability

Reliability concerns the degree to which the results of measurement are consistent across repeated measurements[14].

Table I
Hypotheses and the confirmation or rejection of the hypotheses for hip OA and THR group

HIP OA	THR
1. A correlation of at least 0.5 between the HOOS subscale pain and the SF-36 subscale bodily pain.	
yes	yes
2. A correlation of at least 0.5 between the HOOS subscale pain and the SF-36 subscale physical function.	
yes	yes
3. The correlation between the HOOS subscale ADL and the SF-36 subscale physical function'' is higher than the correlation between the HOOS subscale sport/recreation and the SF-36 subscale physical function.	
yes	yes
4. The correlation between the HOOS subscale pain and the SF-36 subscale bodily pain should be at least 0.1 higher than the correlation between the HOOS subscale pain and the other subscales of the SF-36.	
yes	yes
5. The correlation between the HOOS subscale ADL and the SF-36 physical function should be at least 0.1 higher than the correlation between the HOOS subscale ADL and the other subscales of the SF-36.	
no	no
6. The correlation between the HOOS subscale sport/recreation and the SF-36 subscale physical function should be at least 0.1 higher than the correlation between the HOOS subscale sport/recreation and the other subscales of the SF-36.	
no	no
7. A correlation of at least −0.5 between all the subscales of the HOOS and the OHS.	
yes	yes
8. A correlation of at least −0.5 between the HOOS subscale pain and the VAS for pain.	
yes	yes
75.0% confirmed	75.0% confirmed

To estimate the test−retest reliability of the Dutch HOOS, ICCs (two-way mixed effects model absolute agreement) with 95% confidence interval (95% CI) were calculated. The ICC is generally considered to be good at 0.70 and above[14]. The standard error of measurement (S.E.M.) is the variability in measurements of the same individual and is expressed in the dimension of the measurement. The S.E.M. is calculated as the square root of the sum of the between measures variance and the residual variance[19].

Validity

Validity is the degree to which an instrument measures the construct it is intended to measure. Because of the absence of a gold standard, construct validity was examined. Construct validity is concerned with the extent to which a particular measure relates to other measures consistent with theoretically derived hypotheses for the constructs that are being measured[14]. The construct validity of the HOOS was determined by comparing its results with the generic SF-36, the OHS and the VAS for pain. To evaluate the construct validity of the Dutch HOOS version, Pearson's correlation coefficients were calculated.

Floor and ceiling effects

The presence of floor and ceiling effects may influence the reliability, validity and responsiveness of an instrument. An intervention effect might be missed for people who occupy the maximum score[14]. Floor and ceiling effects were considered present if more than 15% of the respondents achieved the highest or lowest possible score[20].

Results

Table II presents the baseline characteristics of the two study groups. The first group consisted of patients with hip OA. For the test−retest reliability 65 patients were asked to fill in the HOOS questionnaire twice, of which 49 patients replied (response rate of 75%). For the cross-sectional validity 50 other hip OA patients were asked to fill in the HOOS questionnaire, the SF-36, the OHS and the VAS for pain. Thirty-nine patients replied these questionnaires for the cross-sectional validity (response rate of 78%). The second group consisted of patients with a THR. Eighty-five patients were asked to fill the questionnaires for both the cross-sectional validity and the test−retest reliability. Seventy-four patients filled in the questionnaires for the cross-sectional validity (response rate of 87%). Of these 74 patients, 68 patients filled in the HOOS questionnaire twice for the test−retest reliability. No differences were found in the THR group and the hip OA group concerning age (*P*-value of 0.97 and 0.32, respectively) and gender (*P*-value of 0.95 and 0.69, respectively) between the responders and non-responders.

INTERNAL CONSISTENCY

Table III presents the internal consistency expressed by Cronbach's alpha. For each HOOS subscale Cronbach's alpha was above 0.70 in both groups, indicating a sufficient homogeneity of all items in the (sub)scale.

RELIABILITY

Table IV shows the ICC of all subscales of the HOOS for the two study groups. The HOOS questionnaire was completed within 7.6 days, range 3−20 days. For all subscales

Table II
Baseline characteristics of the two study groups

	Hip OA		THR	
	Test−retest reliability ($n=49$)	Cross-sectional validity ($n=39$)	Test−retest reliability ($n=68$)	Cross-sectional validity ($n=74$)
Age in years, median (range)	68.0 (48−80)	66.0 (50−79)	63.1 (31−88)	64.5 (31−88)
Gender, women %	63.3	66.7	67.6	67.6
OA: mild−moderate (%)	49−51	46−54		

Mild: Kellgren & Lawrence score of grade 1. Moderate: Kellgren & Lawrence score of grades 2−3.

Table III
Internal consistency of the HOOS subscales, expressed by Cronbach's alpha

Subscales HOOS	Hip OA ($n=39$)	THR ($n=74$)
Pain (10 items)	0.74	0.76
Symptoms (five items)	0.95	0.94
ADL (17 items)	0.98	0.95
Sport/Rec (four items)	0.91	0.80
QoL (four items)	0.75	0.86

Abbreviations: ADL, function in daily living; QoL, hip-related quality of life.

of the HOOS the ICC was between 0.75 and 0.97 in both groups, indicating a good test–retest reliability.

VALIDITY

The correlations between the HOOS subscales, the SF-36 subscales, the OHS and the VAS for pain are presented in Table V.

The highest correlations between the HOOS and the SF-36 were found for the subscales which intended to measure similar constructs (pain vs bodily pain, $r=0.76/0.75$; ADL vs physical function, $r=0.68/0.72$; Sport/Rec vs physical function, $r=0.58/0.59$). Correlations between the HOOS subscales and the OHS were between $r=-0.62$ and -0.88. Correlations between the HOOS subscale Pain and the VAS-pain were between $r=-0.76$ and -0.68. Of the eight predefined hypotheses about construct validity, 75% could be confirmed (see Table I).

FLOOR AND CEILING EFFECTS

No patient reported the worst or best possible score (floor/ceiling effect) in the HOOS subscales Pain, Symptoms, ADL and QoL. Floor effects (indicating worst possible score) were found only in the subscale Sport/Rec in 5.1% in the hip OA group and in 4.1% in the THR group. No ceiling effects were found in either of the two groups.

DISCUSSION

Based on the results of this validation study of the Dutch version of the HOOS, we consider the HOOS to be an internally consistent, reliable and valid questionnaire (without floor and ceiling effects), for patients with hip OA or a THR.

In a study on hip pain patients without operation, Klassbo *et al.* reported the highest Cronbach's alpha for the subscale ADL and the lowest Cronbach's alpha for the subscale QoL[6]. In the present study the highest Cronbach's alpha was also found for the subscale ADL. The lowest Cronbach's alpha in our study was found for the subscale Pain, which was still considered good (present study vs the study of Klassbo *et al.*: Pain 0.76 vs 0.93, Symptoms 0.94 vs 0.82, ADL 0.95 vs 0.96, Sport/Rec 0.80 vs 0.88 and QoL 0.86 vs 0.77). In the present study some Cronbach's alphas were above 0.90; this means that some of the items of the HOOS questionnaire could have been removed because they may be redundant. Klassbo *et al.* reported that they could have removed some WOMAC items to form a shorter questionnaire; however, they decided to keep all WOMAC items in the HOOS because of the worldwide use of the WOMAC and also because of the possibility to calculate scores for both instruments. Moreover, they could ensure validity for elderly people and also for later stages of hip OA[6].

Klassbo *et al.* validated the Swedish HOOS questionnaire in patients with hip pain without operation of the hip and found a good test–retest reliability (ICC 0.78–0.98)[6]. Our results of the test–retest reliability were similar to that of Klassbo *et al.* (ICC 0.75–0.97). Based on the results of these two studies we conclude that the HOOS is a reliable questionnaire.

To determine whether the test is measuring what was intended to measure requires evidence of validity. Because of the absence of a gold standard, the construct validity was assessed. Correlations between constructs which measure the same constructs were examined. In our study we found the highest correlations between the HOOS subscales and the SF-36 subscales which are intended to measure the same constructs, similar to the study of Nilsdotter *et al.* (THR population)[5]. Compared to the study of Nilsdotter *et al.* we found higher correlations (present study vs study of Nilsdotter *et al.*: ADL vs PF $r=0.72$ vs 0.66, Sport/Rec vs PF $r=0.59$ vs 0.49 and Pain vs BP $r=0.75$ vs 0.61)[5]. The population in the study of Nilsdotter *et al.* was older (mean age 71.5, range 49–85 years) compared to our THR population (mean age 62.5, range 31–88 years). In a study comparing the epidemiology of THR in the Netherlands and Sweden Ostendorf *et al.* reported that the Swedish THR population is generally older compared to the Dutch population[21]. We also compared the HOOS questionnaire

Table IV
Descriptive statistics and test–retest reliability of the HOOS

	Baseline mean (SD)	Retest mean (SD)	Change scores mean (SD)	S.E.M.	ICC agreement	95% CI
Hip OA ($n=49$)						
Pain	51.7 (18.8)	49.3 (21.2)	1.2 (9.8)	6.94	0.88	0.80–0.93
Symptoms	50.7 (20.1)	50.2 (21.9)	−0.1(5.4)	3.77	0.97	0.94–0.98
ADL	51.9 (19.5)	48.5 (21.5)	2.2 (7.0)	5.16	0.94	0.89–0.96
Sport/Rec	38.9 (27.7)	34.9 (27.0)	1.7 (8.1)	5.77	0.96	0.92–0.98
QoL	43.5 (21.5)	42.8 (22.6)	0.4 (5.3)	3.71	0.97	0.95–0.98
THR ($n=68$)						
Pain	64.2 (15.3)	65.4 (14.3)	−0.9 (7.0)	4.97	0.89	0.82–0.93
Symptoms	59.3 (16.6)	60.1 (14.6)	−1.1 (9.2)	6.49	0.82	0.73–0.89
ADL	60.7 (15.9)	62.3 (14.5)	−1.4 (6.7)	4.78	0.90	0.84–0.94
Sport/Rec	43.7 (20.4)	47.2 (20.8)	−3.2 (14.0)	10.07	0.76	0.64–0.85
QoL	40.0 (14.1)	42.8 (14.1)	−2.6 (9.7)	7.03	0.75	0.62–0.84

Abbreviations: SD, standard deviation; S.E.M., standard error of measurement; ICC agreement, intraclass correlation coefficient for agreement; CI, confidence interval. A normalized score (100 indicating no symptoms and 0 indicating extreme symptoms) is calculated for each subscale.

Table V
Validity of the HOOS expressed by Pearson correlations between HOOS subscales and SF-36 subscales, Oxford hip scale and VAS-pain for hip OA ($n = 39$)/THR ($n = 74$)

	HOOS				
	Pain	Symptoms	ADL	Sport/Rec	QOL
SF-36 subscale					
BP	0.76/0.75	0.57/0.48	0.78/0.65	0.63/0.64	0.65/0.53
PF	0.63/0.59	0.56/0.46	0.68/0.72	0.58/0.59	0.47/0.43
SF	0.48/0.34	0.38/0.30	0.46/0.46	0.36/0.40	0.41/0.15
RF	0.49/0.56	0.38/0.49	0.52/0.67	0.55/0.56	0.41/0.41
RE	0.29/0.38	0.18/0.24	0.38/0.43	0.38/0.20	0.14/0.13
MH	0.06/0.25	0.09/0.25	0.10/0.42	0.17/0.23	−0.12/0.13
VT	0.11/0.30	0.14/0.28	0.10/0.34	0.13/0.24	−0.08/0.16
GH	0.33/0.23	0.13/0.04	0.35/0.28	0.31/0.23	0.10/0.02
Oxford	−0.83/−0.85	−0.71/−0.70	−0.88/−0.85	−0.74/−0.69	−0.66/−0.62
VAS for pain	−0.76/−0.68	−0.06/−0.51	−0.73/−0.56	−0.68/−0.49	−0.58/−0.42

Abbreviations: BP, bodily pain; PF, physical function; SF, social function; RF, role limitations because of physical problems; RE, role limitations because of emotional problems; MH, mental health; VT, vitality; GH, general health perception.

with the Dutch version of the OHS; all correlations between HOOS subscales and the OHS were above 0.60. Based on these results we conclude that the HOOS is a valid questionnaire for patients with a THR and for those with hip OA.

The strength of the present study is that we used two different study groups with different stages of hip OA. Besides, we used two questionnaires to evaluate the construct validity of the Dutch version of the HOOS, i.e., a general health questionnaire (SF-36) and a disease-specific questionnaire (OHS).

A measurement tool can also be used to monitor the efficacy of an intervention or the disease process of the patient. For this goal the tool needs to be sensitive to detect clinically relevant changes during a certain period (responsiveness), therefore the responsiveness of the HOOS needs to be evaluated in a future study.

Conclusion

We conclude that the Dutch HOOS questionnaire has a good internal consistency and reliability. Moreover, 75% of the predefined hypotheses about construct validity could be confirmed and we therefore conclude that the construct validity of the HOOS questionnaire is also good. No floor and ceiling effects were found. The HOOS is a good instrument for patients with different stadia of hip OA.

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